LASER PULSE IMAGE SWITCHES

Background - Field of Invention:

[0001] This invention relates to switches and to the use of submillimeter information symbols or scenes on MicroElectroMechanical System (MEMS) mirrors and/or on the exit mirrors of laser diode arrays and the like. Definition: " image " defined as the pattern or form or relative position of photons in an optical pulse, beam or front as it moves through space, optical fibers and the like. These " images " become visible when the photons encounter a surface or are displayed, this is, also, commonly called an image.

Background - Prior Art:

[0002] The use of binary switches and the resulting binary code have required that relatively long code strings be used to represent or transmit simple symbols. The output or product of " LASER PULSE IMAGE SWITCHES " could be a stream (string) of very short (femtosecond) laser pulses, small enough (submillimeter diameter or cross section) to be

carried on optical fiber systems. Each laser pulse being a discrete, separate, submillimeter image of information symbols or scenes and the like.

[0003] The following four patents: Sakuma et al., U.S. Patent #6,292,305 B1; Betensky et al., U.S. Patent#5,745,301; Tanaka et al., U.S. Patent#5,754,712; and Braat, U.S. Patent#6,317,276 B1; disclose operations on images, respectively: display; demagnification; searching, storing and displaying; writing and/or reading. They do not create the image signal or image input. The creation of the image signal or image input as submillimeter images would be the purview of " LASER PULSE IMAGE SWITCHES ".

[0004] Sakuma et al., U.S. Patent # 6,292,305 B1 disclose a virtual screen display apparatus and ... a relatively small image display for displaying characters or image information... [apparently of a size to be human observable] or

"Means to create minuscule alphanumeric images by reflection and by/in the light pulse, for presentation on a real or virtual display screen" (from 2002, April 2 O.A.). As shown in Fig. 15,(Sheet 15 of 20, lower left) and described in Column 1, Lines 5-10 this device displays images which are created by an output device. The creation of these images would be the purview of " LASER PULSE IMAGE SWITCHES ", an output device.

[0005] Lens systems to produce small images of varying magnification for detection by an electronic imaging system or "Lens systems for producing small images" (from 2002, April 2 O.A.) are disclosed by Betensky et al. (U.S. Patent 5,745,301).

[0006] An image processing apparatus for searching, storing, and displaying characters, sentence fragments, sentences or documents or "A device for searching any character string of a sentence input as an image" (from 2002, April 2 O.A.) is disclosed by Tanaka et al. (U.S. Patent 5,754,712).

[0007] An optical lens system and scanning device for reading and/or writing information in an information plane or "An optical scanning device for reading and writing information in an information plane" (from 2002, April 2 O.A.) is disclosed by Braat (U.S. Patent 6,317,276 B1).

[0008] The absolute/unique distinction between, the four patents referenced above (Sakuma et al., Betensky et al, Tanaka et al., and Braat) and "LASER PULSE IMAGE SWITCHES", can be demonstrated by reference to Sakuma et al., U.S. Patent 6,292,305 B1, Sheet 15 of 20, FIG. 15. In the lower left corner of FIG. 15 is the term "IMAGE SIGNAL", to the left of that would be the purview of "LASER PULSE IMAGE SWITCHES".

[0009] The same distinction would apply to the other three patents: Tanaka et al., U.S. Patent 5,754,712, Sheet 1 of 23, FIG. 1, upper left, "IMAGE INPUT UNIT", above that would be the purview of "LASER PULSE IMAGE SWITCHES".

Betensky et al., U.S. Patent 5,745,301, ABSTRACT, First sentence, "Variable power lens systems for use with electronic imaging systems, e.g. systems employing CCDs, are provided." , would be synergistic with the purview of "LASER PULSE IMAGE SWITCHES".

Braat, U.S. Patent 6,317,276 B1, ABSTRACT, Last sentence, "This lens system is very suitable for a scanning device and an apparatus for reading/writing high-density optical discs." , would be synergistic with the purview of "LASER PULSE IMAGE SWITCHES".

[0010] "LASER PULSE IMAGE SWITCHES" would likely be synergistic with OCR equipment.

[0011] The prior four patents refer to operations performed on images which could be created, or produced by " LASER PULSE IMAGE SWITCHES ".

[0012] "An electrically actuated microelectromechanical television scanning device for television image scanning or related functions. The scanning device can be produced in forms having characteristic dimensions in the submillimeter range. ..." is disclosed by Johnson (U.S. Patent 5,673,139). This patent does not show or infer any attempt or concept to create, form or etch, submillimeter information symbols or scenes onto the switch elements, i.e. optical surfaces (mirrors, laser diode exit mirrors, liquid crystal elements, or the like). Hence, Johnson, U.S. Patent 5,673,139, does not anticipate "LASER PULSE IMAGE SWITCHES".

[0013] A "... light-actuated photonic switch is disclosed..." by Aksyuk et al., U.S. Patent 6,075,239. This patent does not describe any attempt or concept of creating, forming or etching submillimeter information symbols or scenes onto the switch elements, i. e. optical surfaces (reflectors, mirrors, or the like). Hence, Aksyuk et al., U.S. Patent 6,075,239, does not anticipate " LASER PULSE IMAGE SWITCHES ".

[0014] " A cross-connect switch for fiber-optic communication networks employing a wavelength dispersive element, such as a grating, and a stack of regular (non-wavelength selective) cross bar switchs using two-dimensional arrays of micromachined, electrically actuated, individually-tiltable, controlled deflection micro-mirrors for providing multiport switching capability for a plurality of wavelengths. ..." is disclosed by Solgaard et al., U.S. Patent 6,389,190 B2. The word " image " is used in several places in Column 2, it is clear ,from the context, that the meaning is to position or focus the optical beams onto mirrors or fiber ends. This patent does not describe any attempt or concept of creating, forming, or etching submillimeter information symbols or scenes on the switch elements, i.e. optical surfaces (micro-mirrors, gratings, or the like). Hence, Solgaard et al., U.S. Patent 6,389,190 B2, does not anticipate " LASER PULSE IMAGE SWITCHES ".

[0015] These patents: Johnson,U.S.Patent 5,673,139 , Aksyuk et al., U.S. Patent 6,075,239, and Solgaard et al., U.S. Patent 6,389,190 B2, are likely to be synergistic with " LASER PULSE IMAGE SWITCHES ".

[0016] The unique, enabling paradigm of " LASER PULSE IMAGE SWITCHES " is the creation, formation or etching of submillimeter information symbols or scenes onto the optical surface(s) of MEMS mirrors, exit mirrors of laser diode arrays, submillimeter liquid crystal displays, and the like; and the creation of submillimeter optical images of these submillimeter information symbols or scenes with very short pulses, of submillimeter dimension (diameter, etc.), of laser light; and the selective switching of these laser pulses to create a string of submillimeter images. The prior patents do not infer, suggest, or describe this paradigm.

Objects and Advantages:

[0017] Submillimeter information, including scenes and/or alphanumeric symbols, on the mirrors of MEMS switches, and/or the exit mirrors of laser diode arrays and the like, allow the representation, switching and/or transmission of submillimeter images with very short pulses of laser light.

[0018] One embodiment, an array of 256 submillimeter image switch elements (MEMS mirrors, laser diode arrays and the like) with submillimeter alphanumeric symbols on each switch element could function as an submillimeter alphanumeric image string switch.

[0019] The use of a, sequence label, in the switch address system would allow switching to any/all of the 256 image switch elements in any sequence, with each address operation. By including a, sequence plus time index label, the potential submillimeter alphanumeric image string can become extremely long for each address operation.

[0020] The advantage of laser pulse image switches would be the increased efficiency of directly switching, transmitting, manipulating, and storing information as submillimeter images of alphanumeric symbols or scenes, without the archaic conversion into binary code and the subsequent decoding.

Summary:

[0021] Submillimeter information symbols or scenes formed on MEMS mirrors and/or the exit mirrors of laser diode arrays and the like, allow these devices to function as laser pulse information image switches, producing a string of laser light pulses, each an image of a submillimeter information symbol or scene. These switches would be used in optronic/photonic devices and systems/networks.

Description:

[0022] Submillimeter information symbols or scenes, (reflective or nonreflective, positive or negative), are etched or formed onto the mirrors of MEMS switches and/or the exit mirrors of laser diode arrays and the like (other optical switch devices including liquid crystal devices). By selectively switching which MEMS mirror reflects a laser light pulse (submillimeter) or which laser diode emits a laser light pulse (submillimeter), these devices function as laser pulse image switches.

Operation:

[0023] A light pulse (submillimeter), reflected or emitted from a laser pulse image switch element would form a submillimeter image of the symbol(s)/scene(s) on that element. These pulses could be ultra-short(femtosecond) and each pulse, a discrete, separate, and different image. The light pulse image(s) could be directed into an optical fiber for transmission. Projection of the light pulse image(s) onto a CCD chip (or screen) would provide

readout. Storage might be recording of the symbol image(s) directly onto a CD (or with light stopping methods of Rowland Institute).

Conclusion, Ramifications and Scope:

[0024] The limiting factor may be the number of photons necessary to form an image. Many paths toward that limit appear possible: for example, extremely small symbols, extremely short light pulses, multiple symbols on each switch element, lens systems, very high element number switches; i.e. current MEMS switches have 256 mirrors (possible symbols), frequency multiplexing; i.e. each frequency of the light pulse forming an image, and reflective symbols on a nonreflective background. Alternatively: symbols might be formed directly onto the exit mirrors of submillimeter lasers such that the laser pulse, itself, is the image; or submillimeter images created by passing the light pulse through a submillimeter, liquid crystal image medium.

Eventually, a submillimeter image may be worth a thousand bits.